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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 760

OFFICE OF THE SECRETARY

Joint Contribution from the Office of Farm Management
R. L. ADAMS, Acting Chief
and
Bureau of Plant Industry
W. A. TAYLOR, Chief

Washington, D. C. ▼ March 14, 1919

FARM PRACTICE IN GROWING SUGAR BEETS IN THREE CALIFORNIA DISTRICTS

By

T. H. SUMMERS, Scientific Assistant, L. A. MOORHOUSE, Agriculturist, and R. S. WASHBURN, Scientific Assistant, Office of Farm Management

and

C. O. TOWNSEND, Pathologist in Charge of Sugar-Plant Investigations, Bureau of Plant Industry

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The data presented in the following pages are based upon 165 farm records obtained in three typical sugar-beet regions of California. (See fig. 1.) The first part of the bulletin deals with farm practice in the production of the sugar beet. The second part discusses the requirements of the beet crop in terms of the values that prevailed during 1915 and 1916. If such requirements are known, that is, the amount of labor, seed, water, etc., used, the cost of producing sugar beets can be ascertained for any given crop year by substituting current rates for those used in this study. Actual costs for 1915–1916 are presented solely for purposes of comparison.

Eighty-one records were obtained south of Los Angeles, in Los Angeles and Orange Counties; 45 were taken at Oxnard, in Ventura

NOTE.—This bulletin is the fourth of a series of publications which have been prepared to give the results of an investigation dealing with the farm practice involved in growing sugar beets in four of the more important sugar-beet areas in the United States. The first bulletin dealt with this study in Utah and Idaho, the second took up the work in Colorado, and the third gave the results obtained in Michigan and Ohio.

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County; and 39 records were obtained at Salinas, in Monterey County. The Salinas records apply to the 1916 crop, while records obtained in the two other areas are for the 1915 and 1916 crops.

While the suggestions that have been made as a result of this sur-

FIG. 1.—Map of California showing the districts in which records were obtained and indicating the beet-sugar factory areas of this State. It will be seen that the southern part of the State possesses a majority of the factories now in operation.

vey are directly applicable to the districts in which the records were taken, it is believed that certain features relating to increased production will be of very great value to men who are growing this crop in other regions.

ERRATUM.

In the explanation of the symbols in figure 1, designating factories operating and factories idle, 1915-1916, the symbols should be reversed. Only two factories, Hamilton City and Corcoran, were idle in 1915-1916.

SUMMARY OF RESULTS.

Briefly, these are the more important facts brought out in this study of 165 California sugar-beet farms:

Tillable area in sugar beets: Los Angeles district, 68 per cent; Oxnard, 34 per cent; Salinas, 52 per cent.

No definite cropping system is followed. Sugar beets are sometimes grown on the same land for as many as 10 successive years. Other important crops are beans and barley.

All available farm manure is spread upon beet land, but so little manure is available that only a small fraction of the beet acreage is manured each year.

Average yields (1915–1916): Los Angeles, 14.52 tons per acre; Oxnard, 9.53 tons; Salinas, 15.59 tons.

Cost per acre (1915–1916): Los Angeles, $67.11; Oxnard, $54.88; Salinas, $66.45. In general, as acreage increases cost per acre decreases, while as yield increases cost per acre increases though cost per ton decreases.

Labor constitutes 50 per cent of total cost of production; use of land, 35 per cent.

Beet tops were fed on the majority of the farms in the Los Angeles and Oxnard areas. At Salinas 56 per cent of the growers plowed under the tops. The value of this by-product depends on the method of utilization. The highest value was put on the tops when used as feed.

METHOD OF INVESTIGATION.

Experienced enumerators visited the growers and obtained information as to the number of times the beet land was plowed, disked, harrowed, rolled, etc., the size and kind of implements used, the size of the crew worked, and the time required to perform these operations, the season of the year when the work was done, and the materials used, such as manure, fertilizer, seed, and irrigation water. Each grower was also asked to outline his cropping system. In short, a complete record of the sugar-beet crop was obtained, and sufficient data on other farm crops and live stock to make possible a study of the entire farm business. Enough of these records were obtained so that variations in individual estimates were more or less equalized in the averages. A comparison of farmers' estimates with actual figures taken from the books of the beet-sugar factories in two districts indicates the reliability of the results obtained by this method. (Table I.) Figures for the Los Angeles district are omitted, as a number of growers contracted a part of the acreage to one factory and the remainder to another. For similar reasons several growers in the other districts are not included in this table. It will be noted

that there was a slight tendency on the part of the grower to overestimate.[1]

TABLE I.—*Comparison of farmers' estimates with factory records (crop year 1916).*

District.	Number of farms.	Number of acres in beets.		Tons per acre.		Total receipts.	
		Farmers'.	*Factory.*	*Farmers'.*	*Factory.*	*Farmers'.*	*Factory.*
Oxnard	11	122.21	124.52	10.94	10.88	$10,731.26	$10,102.78
Salinas	31	92.13	90.16	15.42	15.73	8,044.71	7,556.48

HISTORY AND DEVELOPMENT OF THE SUGAR-BEET INDUSTRY IN CALIFORNIA.

As early as 1856 a small beet-sugar factory was built at Ocean View near San Francisco, which failed in a few years. In 1869 and

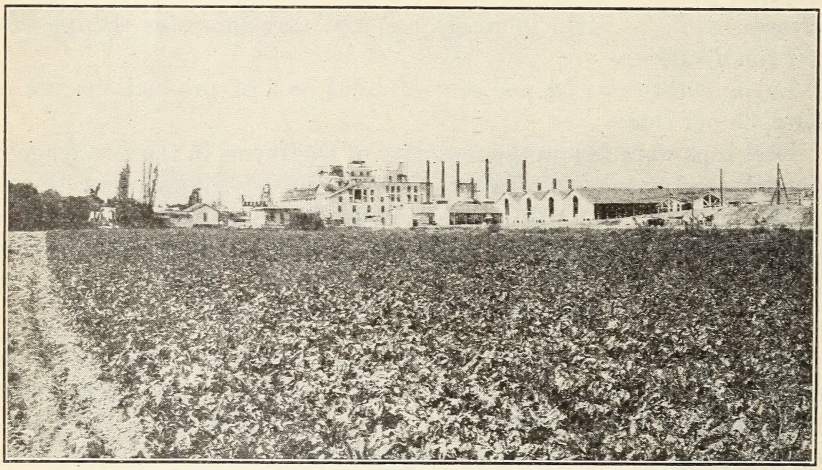

FIG. 2.—Beet-sugar factory at Alvarado, Cal. It was on this site that the beet-sugar industry had its beginning on the Pacific Coast.

1870 a beet-sugar factory having a capacity of 50 tons was erected at Alvarado and was operated under the name of the California Beet Sugar Manufacturing Co. After operating four years it was sold to a concern in Santa Cruz County, which failed in 1876. The

[1] The Office of Farm Management and the Office of Sugar-Plant Investigations worked in cooperation in securing the records. The former office was primarily interested in the labor requirements of the crop and farm organization in the sugar-beet areas. The latter office was concerned with the methods of growing the crop, as well as with the study of the effect of certain pests and diseases upon production.

Acknowledgment is due to the many farmers through whose liberal contribution of time and information this publication has been made possible, and to the sugar-factory officials who furnished the figures from the company books for comparison with the farm estimates.

Acknowledgment is also due S. B. Nuckols and James W. Jones, Agriculturists, Office of Sugar-Plant Investigations, who assisted in obtaining the field records from the growers.

factory opened again for one year in 1880. About this time a new company was formed, which increased the capacity to 100 tons daily, but in 1886 the factory was partially destroyed by fire and the enterprise failed. In 1887 and 1888 the factory was rebuilt and sold to the Alameda Sugar Co. The plant was subsequently enlarged in 1890. This factory in 1916 had a daily slicing capacity of 800 tons. (See fig. 2.)

Other attempts to establish the beet-sugar industry were made at Brighton and Isleton, but these met with no success. In 1888 a plant was built at Watsonville with a 300-ton capacity. This was soon enlarged to 1,000 tons, but was later dismantled. In 1898 the Spreckels plant was erected at Spreckels, Cal., with a 3,000-ton capacity. This

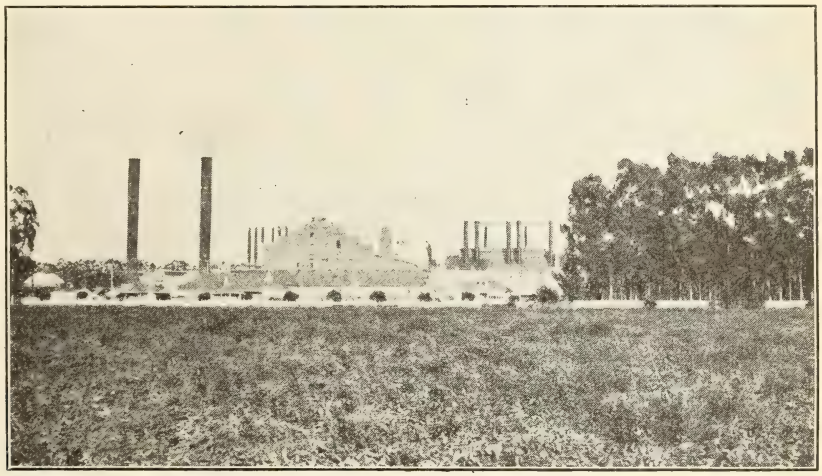

FIG. 3.—A modern beet-sugar factory in the Oxnard area. This factory has a daily slicing capacity of 3,000 tons of sugar beets.

factory has become the largest in the United States, and in 1916 sliced an average of 4,500 tons daily.

At the close of the 1890 slicing season there were only three factories in the United States, two in California and one in Nebraska. Following is a list of the beet-sugar factories now in California:

Location.	Date erected.	Capacity.	Location.	Date erected.	Capacity.
		Tons.			*Tons.*
Alvarado	1870	800	Visalia	1906	400
Chino	1891	1,100	Santa Ana	1908	600
Los Alamitos	1897	800	Corcoran	1908	600
Oxnard	1898	3,000	Huntington Beach	1911	1,200
Spreckels	1899	4,500	Anaheim	1911	850
Betteravia	1899	1,000	Dyer	1912	1,200
Hamilton City	1906	700			

During 1915–1916 two of these plants (Corcoran and Hamilton City) were not operating.

The industry has grown rapidly. During the 5-year period from 1913 to 1917 over 20 per cent of the entire acreage of sugar beets in the United States was grown in California. In 10 years, 1899–1909 (see Table II) the acreage almost doubled, while the tonnage increased more than 100 per cent. The yield per acre was also increased 2.1 tons, or about 24 per cent. In the same period the total acreage in the United States had increased about three times, while the total yield had become five times as great as in 1899.

TABLE II.—*California sugar-beet acreage and yield.*

Census.	Year.	Acres in beets.	Total production (tons).	Yield per acre (tons).	Beet acreage in United States.	Total production in United States (tons).
Twelfth	1899	41,242	356,535	8.6	110,170	793,353
Thirteenth	1909	78,957	845,191	10.7	364,093	3,932,857

The following data from the Crop Reporter of the United States Department of Agriculture show the acreage and yield of sugar beets in California from 1910 to 1917. (Table III.)

TABLE III.—*Acreage and yield of sugar beets in California.*

Year.	Acres harvested.	Total production.	Yield per acre.	Sugar made.
		Short tons.	*Short tons.*	*Short tons.*
1910	90,500	923,100	10.20	139,890
1911	99,545	1,037,283	10.42	161,300
1912	111,416	1,004,328	9.01	158,904
1913	127,610	1,138,003	8.92	171,208
1914	104,000	1,126,700	10.83	169,004
1915	122,737	1,249,111	10.20	195,343
1916	141,097	1,462,895	10.36	236,322
1917	154,700	1,318,400	8.53	200,100

AGRICULTURE OF AREAS STUDIED.

CLIMATE.

The climate of the region studied is characterized by two seasons, one wet and the other dry. Practically all of the precipitation occurs during the period from November to March. The average annual rainfall for the three areas is fairly uniform, ranging from 14.06 to 15.73 inches. However, in 1915 and 1916 the rainfall was in excess of the average. Records were obtained covering both the 1915 and 1916 crop years at Los Angeles and Oxnard. In this way the effect of the fluctuation in the annual precipitation has been considered. (See Table IV.)

TABLE IV.—*The annual average rainfall by months for three sugar-beet districts in California.*

	Los Angeles. 1877–1909. Elevation 293 ft.	Oxnard. 1892–1912. Elevation 150 ft.	Salinas. 1873–1912. Elevation 40 ft.
January	3.03	3.96	3.02
February	3.00	2.44	2.21
March	3.05	3.09	2.50
April	1.02	0.44	1.18
May	0.48	0.43	0.49
June	0.08	T[1]	0.13
July	0.01	0.01	T[1]
August	0.03	T[1]	0.01
September	0.10	0.48	0.19
October	0.75	0.79	0.68
November	1.33	1.03	1.33
December	2.85	2.08	2.32
Total	15.73	14.75	14.06
Total:			
1915	16.67	19.38	18.24
1916	23.29	28.01	18.81

[1] A trace of moisture only.

In the Los Angeles area the normal monthly temperature ranges from 53° to 70°, at Oxnard from 52° to 64°, and at Salinas from 47° to 62°. Generally speaking, no irrigation is practiced at Oxnard; at Salinas it is frequently advisable to irrigate the land before it is plowed for beets (see fig. 4), and at Los Angeles it is often necessary to irrigate at least once during the growing season. The prevalence of fogs during the dry season plays an important part in the conservation of moisture. In all areas the average temperature during the growing season approaches 70°, the temperature recognized as being necessary for sugar-beet production.

SOIL.

Several soil types are found in the three areas studied. A brief reference to these types will undoubtedly assist the reader in his interpretation of the cultural methods which are described in this bulletin. The amount of work that may be required in the preparation of a good seed bed is governed to a certain extent by the character of the soil. Very heavy land must be cultivated at the proper time if the minimum labor requirement is to be attained.[1]

Most of the records in the Los Angeles district were taken on two types of soil, Fresno fine sandy loam and Fresno sand. By far the

[1] In 1901 the Bureau of Soils, United States Department of Agriculture, made a survey of the Salinas Valley and the Ventura area, the latter including the Oxnard district. In 1903 the Los Angeles area was surveyed, so that all three areas have been mapped by the Bureau of Soils. (Soil Survey of the Los Angeles Area, California, by Louis Mesmer, 1903. Soil Survey of the Ventura Area, California, by J. Garnett Holmes and Louis Mesmer, 1901. Soil Survey of the Lower Salinas Valley, California, by Macy H. Lapham and W. H. Heileman, 1901.)

most of the sugar beets were grown on the former. In the Oxnard district there are two soil types, Oxnard sandy loam and Oxnard sand. As is suggested by the name, the Oxnard sand is the coarser and more open of the two and contains less organic matter. The sandy loam is probably better adapted to sugar-beet production than is the sand. In the Salinas district the records were obtained on three types of soil, Salinas gray adobe, San Joaquin black adobe and Fresno fine sandy loam. Salinas gray adobe is very sticky when wet, becoming hard when dry. It holds moisture well. At certain seasons of the year it is very heavy to work. San Joaquin

FIG. 4.—A field which has received an application of waste water from the beet-sugar factory. This water contains considerable lime, which is deposited on the surface of the field. The whitened portions of the ground indicate that the surplus water flowed into these areas and the lime was left after the water had passed into the soil.

black adobe is similar to Salinas gray adobe, and is probably a little better adapted to sugar-beet production. Sugar beets are grown also on Fresno fine sandy loam, but they probably do best on the adobe soils.

SIZE OF FARMS.

The relation of the sugar-beet enterprise to size of farm may be seen in part by comparing the Thirteenth Census figures with the distribution of the records obtained in this investigation (see Table V).

TABLE V.—*Distribution of farms by size in Los Angeles, Ventura, and Monterey counties, and in the groups in which the records obtained appear (1915–1916).*

Size.	Los Angeles County.		Ventura County.		Monterey County.	
	Thirteenth Census.	Farm records.	Thirteenth Census.	Farm records.	Thirteenth Census.	Farm records.
9 acres and under	3,122	.....	100	.....	80	.....
10 to 49 acres	5,374	9	319	1	253	1
50 to 99 acres	1,049	37	214	8	185	9
100 to 174 acres	706	14	207	14	263	12
175 to 259 acres	252	10	142	16	127	10
260 to 999 acres	459	10	245	6	507	7
1,000 acres and above	122	1	66	.....	243	.....

In Los Angeles and Ventura Counties, according to the Census figures, the largest group of farms is that of from 10 to 49 acres, while in Monterey County there are more farms in the 260 to 999 acre group than in any other class, and 243 of 1,000 acres and above.

The numbers of farm records obtained in these groups are not quite in proportion to the Census figures. In Los Angeles County there are many small farms in the suburbs of the city of Los Angeles, over 75 per cent of the farms in the county having an acreage of 49 acres or less. Many of these small farms grow beets, but have such small acreages that they are not comparable with the larger sugar-beet farms. No records were used from farms with less than 5 acres of beets. The largest number of records was obtained in the 50 to 99 acre group.[1]

The beet farms visited in the other two areas are, as a rule, larger, most of them being in the 100 to 259 acre groups.[2]

CROPS GROWN.

The number of major crops in each district was rather small. (See Table VI.) In the Los Angeles district sugar beets, alfalfa, and barley hay were the principal crops; in the Oxnard district sugar beets, beans, and barley; at Salinas, sugar beets, barley hay, and beans.

[1] It is the practice in this region for a grower owning a small farm to rent additional land. The total acreage farmed in such cases is considered the farm unit. This accounts for the apparent inconsistency in the table.

[2] One peculiarity in these districts is the lack of uniformity in size. Instead of being 40, 80, 120, or 160 acre farms as in other Western States, the farms are of many different sizes. This is probably due to the breaking up of the land grants and the selling of the land in small irregular acreages.

TABLE VI.—*Crop acreages per farm and average yields per acre.*

District and crop.	Number of farms.	Per cent of total farms.	Acres per farm.	Yield per acre.
Los Angeles (average tillable area, 140 acres):				
Sugar beets	81	100	95.2	14.52 tons.
Alfalfa	27	33	14.11	6.82 tons.
Barley hay	24	30	61.4	1.28 tons.
Corn	17	21	35.49	
Beans	12	15	45.5	12.37 cwt.
Barley grain	2	2	140	30.84 cwt.
Potatoes	2	2	8	83 cwt.
Oxnard (average tillable area, 183 acres):				
Sugar beets	45	100	62.47	9.53 tons.
Beans	42	93	87.57	13.43 cwt.
Barley hay	23	51	27.65	1.48 tons
Alfalfa	9	20	9.33	4.88 tons
Wheat hay	6	13	61.33	1.74 tons.
Barley grain	2	4	11	26.54 cwt.
Potatoes	2	4	.75	94.4 cwt.
Corn	2	4	3	
Salinas (average tillable area, 178 acres):				
Sugar beets	39	100	92.72	15.59 tons.
Barley hay	30	77	35.93	2.42 tons.
Beans	15	38	27	10.28 cwt.
Barley grain	15	38	59.13	36.95 cwt.
Potatoes	14	36	22.82	70.85 cwt.
Alfalfa	7	18	16.57	4.74 tons.
Peas	4	10	43.25	22.98 cwt.

On all farms where records were obtained sugar beets and beans were the principal cash crops. In the Oxnard district, beans were grown on 93 per cent of the farms visited. Barley hay was produced on 77 per cent of the Salinas farms. In all districts the major portion of the barley crop was grown for hay. On 38 per cent of these farms barley was grown for grain.

Twenty-one per cent of the farmers reporting in the Los Angeles area grew corn. As a part was husked and the remainder fed as fodder, no attempt was made to determine the yield per acre.

Alfalfa was grown on 33 per cent of the Los Angeles farms studied in this investigation and was cut an average of six times during the season. On Oxnard farms five cuttings were made, in the Salinas district three. Peas for seed were grown on 10 per cent of the Salinas farms.

In addition to the crops shown in the table a small acreage in each district was devoted to fruit, and in the Los Angeles district a small amount of cauliflower and other vegetables was grown.

No attempt has been made in any case to establish a definite crop rotation, nor is the acreage grown from year to year at all uniform. On 78 per cent of the farms in the Los Angeles district beets followed beets, and on a few farms the sugar beet had been grown continuously on the same land for as many as 10 years. Beets followed beans on only five farms.

In the Oxnard district beets were grown immediately after beets on 51 per cent of the farms. It is a common practice in this area to grow beets continuously on land that is slightly alkaline, while

beans are grown continuously on the better-drained and more valuable land. The fact that the beet is grown on the less productive land may explain in part the relatively low yield in this district. A few of these men occasionally grow a crop of barley on the beet land, while others sometimes let it lie fallow for a season.

In the Salinas area beets were grown after beets on 64 per cent of the farms. The tendency to rotate occasionally with barley was more in evidence here than in the other districts visited.

Considering the benefits that are usually obtained through following a well-planned cropping system, it would seem that the crop land in these areas is not as well managed as would seem to be advisable.

RELATION OF BEET ACREAGE TO TILLABLE AREA.

The total acreage per farm averages about 200 acres at Salinas, 195 at Oxnard, and 150 at Los Angeles. About 93 per cent of the farm land in the Los Angeles area is tillable and in the Oxnard district 94 per cent is tillable. At Salinas the figure drops to 89 per cent.

At Los Angeles and Salinas more than 50 per cent of the tillable land is utilized by the beet crop, while at Oxnard over one-third of the tillable area is devoted to beets.

FARM PRACTICES.

SCATTERING BEET TOPS.

Beet tops are usually plowed under in the Salinas area. Tops are of considerable value for fertilizing the land, the best results being obtained when they are evenly distributed over the field. The beet tops when cut are usually left in rows, with occasional small piles in the row. Before the land is plowed for the succeeding crop of beets the tops are sometimes scattered over the field with a harrow. This operation is known as "scattering tops." One harrowing is sufficient to do the work. Fifty per cent of the Salinas growers scattered the beet tops before plowing. An average crew of one man and six horses was used, with a 16-foot harrow. The time required per acre was 0.42 man hours and 2.47 horse hours, the labor cost per acre being 34 cents.[1]

MANURING.

In the California areas farm manure is exceedingly scarce. Although it is the general practice to spread all available manure upon the beet land, in the Oxnard area only about 9 per cent of the beet

[1] In computing the cost of labor a uniform rate of 10 cents per hour was used for horse labor. The man-labor rate at Oxnard and Salinas was 21 cents per hour, while at Los Angeles a man-labor rate of 20 cents per hour was used.

acreage was manured, at Los Angeles only 6 per cent, and at Salinas 2¼ per cent.

Sixty-nine per cent of the Los Angeles growers applied manure to the beet land, 62 per cent of the Oxnard growers, and 54 per cent of the Salinas growers. (See Table VII.)

TABLE VII.—*Manuring.*

District.	Number of records.	Acres manured per farm.	Tons applied per acre.	Hours of labor per acre.		Labor cost per acre.
				Man.	Horse.	
Los Angeles	56	8.33	13.70	15.81	24.22	$5.58
Oxnard	28	8.93	10.83	13.29	28.02	5.59
Salinas	21	3.90	11.82	13.21	19.94	4.76

A crew of 1 man and 2 horses was used in hauling manure on 39 farms. On 27 farms the crew was 2 men and 2 horses. Twelve operators hauled with a crew of 1 man and 3 horses, while 13 growers with the same number of horses provided an additional man to assist with the loading, etc. Two men and four horses were used on nine farms. Approximately two-thirds of these growers hauled manure with wagons; slightly more than one-third used spreaders.

Twenty-six operators applied manure during the fall, 20 did this work throughout the winter months, a few at odd times during the fall, winter, and spring, and in one case the work was done in summer.

There was little variation in labor cost for the first two areas ($5.58 and $5.59), but at Salinas the total labor cost was considerably less ($4.76).

PLOWING.

For the successful production of an intensive crop like the sugar beet, it is necessary to have a deep, well-prepared seed bed. In regions where rainfall is limited and occurs mainly during the winter, as in California, it is especially desirable to practice deep fall plowing. This enables the soil to store a large quantity of water during the rainy period and increases the yield by facilitating the development of a beet with a long tap root. On the farms included in this study the depth of plowing ranged from an average of 9.5 inches in the Salinas district to 11.5 inches in the Oxnard district.

Most of the plowing on the farms in question was done from October 1 to February 1. A small number of growers practiced spring plowing, but all customarily had finished this operation by May 1.

Eighteen men replowed all or a portion of their beet acreage during March and April to an average depth of 5 inches. The average

number of times plowed for all sections was 1.1. Replowing was necessary mainly because weeds had not been kept in control during the winter.

Ninety-one per cent of the men in the Los Angeles and Oxnard districts and 86 per cent in the Salinas district used horsepower. (See Table VIII.) In the Los Angeles area a 1-man-4-horse crew was reported on 15 farms and a 1-man-6-horse crew on 28 farms. In the Oxnard area a larger crew size predominated, a 1-man-8-horse crew being reported on 20 farms and a 1-man-10-horse crew on 10 farms. In the Salinas area a 1-man-6-horse crew was reported on 15 farms and the 1-man-8-horse crew on 15 farms.

TABLE VIII.—*Plowing with horses.*

District.	Number of records.	Per cent of total records.	Acres per farm plowed for beets.	Hours of labor per acre.		Labor cost per acre.
				Man.	Horse.	
Los Angeles	74	91	80.24	4.66	24.83	$3.41
Oxnard	41	91	45.80	3.95	26.72	3.50
Salinas	35	86	79.51	3.13	21.72	2.83

For all districts considered together 11 per cent used a 1-man-4-horse crew, 31 per cent a 1-man-6-horse crew, 27 per cent a 1-man-8-horse crew, and 7 per cent a 1-man-10-horse crew. In addition to the above a few other crew sizes appeared in the three districts, such as the 1-man-3-horse, 1-man-5-horse, 1-man-7-horse, and 1-man-9-horse crews.

The average depth of plowing ranged from 10.75 inches for the 1-man-4-horse crew, to 12.8 inches for the 1-man-10-horse crew. The labor requirements varied from an average of 5.2 man hours and 20.8 horse hours per acre for the 1-man-4-horse crew, to 2.8 man hours and 28 horse hours per acre for the 1-man-10-horse crew. From the above it will be seen that there was a distinct saving in the man labor requirements through the use of the larger crew. However, the additional horse-labor requirements for the larger crew made the total labor cost 23 cents more for the 1-man-10-horse, than for the 1-man-4-horse crew.

In the Los Angeles district 14- to 16-inch sulky plows were most in evidence, 56 of this size being reported. In the Oxnard and Salinas districts, however, the 2-gang, 24- to 28-inch plow was the popular size, 28 being reported in the former and 27 in the latter area. (See fig. 5.)

For all districts 11 men were found who had all or a portion of their beet acreage plowed on contract with tractor power, at a rate ranging from $3 to $4 per acre. Twelve men plowed the beet acre-

age with their own tractors. Two- to 4-gang 14- to 16-inch plows were used, and the ground was plowed to an average depth of 12 inches. The man-labor requirement averaged 1.77 hours per acre, involving a labor cost of 37 cents per acre. (See fig. 6.)

CHISELING.

The field chisel or deep cultivator, as it is often called, has two staggered rows of rigid, narrow teeth, firmly attached to an iron frame which is supported on wheels at either end. (See Table IX.) Hand levers which are attached to the frame insure an accurate adjustment of the depth of cultivation. On loose, spring-plowed land, the deep cultivator is used to firm and compact the

FIG. 5.—Plowing with an ordinary sulky. The crew in this case consisted of one man and six mules.

soil for the entire depth of the seed bed. When the chisel is used for this purpose it should be followed soon after by a spike-tooth harrow to create a dust mulch to lessen evaporation. On the heavier soil types, such as are found in the Salinas area, the deep cultivator serves to loosen up the surface soil which has become compact, and at the same time to subdue weeds.

TABLE IX.—*Chiseling.*

District.	Number of records.	Per cent of total records.	Acres in beets per farm.		Times chiseled.	Hours of labor per acre.		Labor cost per acre.
			Total.	Chiseled.		Man.	Horse.	
Los Angeles	7	9	119.29	97.86	1.43	2.07	14.40	$1.85
Oxnard	5	11	93.20	53.20	1.20	1.90	12.76	1.68
Salinas	34	87	88.85	88.12	1.28	1.69	12.93	1.64

Of a total of 46 farms where chiseling was reported, 61 per cent used a 1-man-8-horse crew, and 24 per cent a 1-man-6-horse crew. The width of the implement ranged from 5 feet to 8 feet, with an average of about 5½ feet. This work was performed mainly during the months of March and April.

In the Salinas area where the majority of the growers used this implement, practically the entire beet acreage was covered with the chisel in each case (Table IX), while in the Los Angeles and Oxnard districts 82 per cent and 57 per cent, respectively, of the beet acreage was covered on the few farms using this implement. However, 22 men at Los Angeles and 25 at Oxnard used the spring tooth, which serves much the same purpose as the chisel.

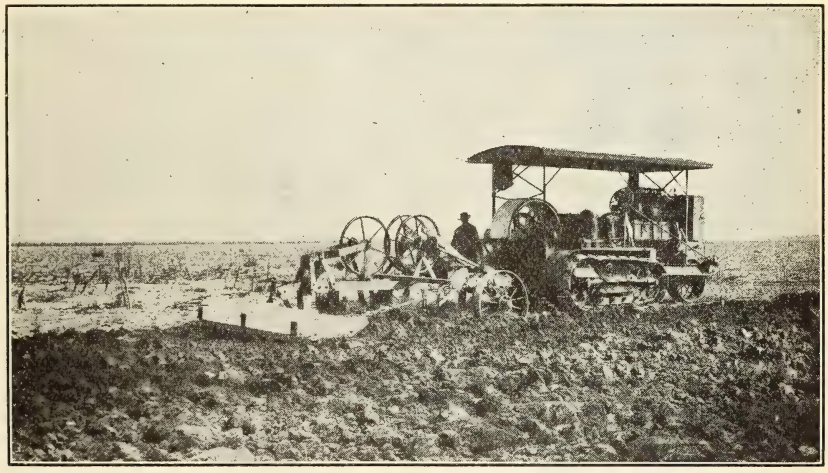

FIG. 6.—Dry plowing with a tractor. It will be observed that a float or planker is being operated simultaneously with the plow.

In addition to those included in the table, three men in the Salinas district did the work of chiseling with tractor power. One of these had an 8-foot double disk and an 8-foot spike-tooth harrow attached behind the chisel. Another had a 10-foot spike-tooth harrow attached. The average man-labor requirement for tractor chiseling was 1½ hours per acre.

DISKING.

The disk harrow was used on a relatively small number of farms. (See Table X.) Disking breaks up surface clods, kills the weeds, and firms the seed bed. Occasionally, where the harvesting of a preceding crop has left the surface of the field rough, this condition is corrected by disking the ground prior to plowing.

TABLE X.—*Disking.*

District.	Number of records.	Per cent of total records.	Acres disked per farm.	Times disked.	Hours of labor per acre.		Labor cost per acre.
					Man.	Horse.	
Los Angeles	25	31	63.44	1.15	1.18	6.47	$0.89
Oxnard	8	18	62.88	1.88	1.25	8.28	1.09
Salinas	8	20	78.38	1.38	1.05	7.30	.95

Two types of disk were used, the single action and the double action. The latter type has two sets of disks, one set in front of the other and so adjusted that the front set throws the soil out while the rear set throws it in, thus leaving the ground smooth.

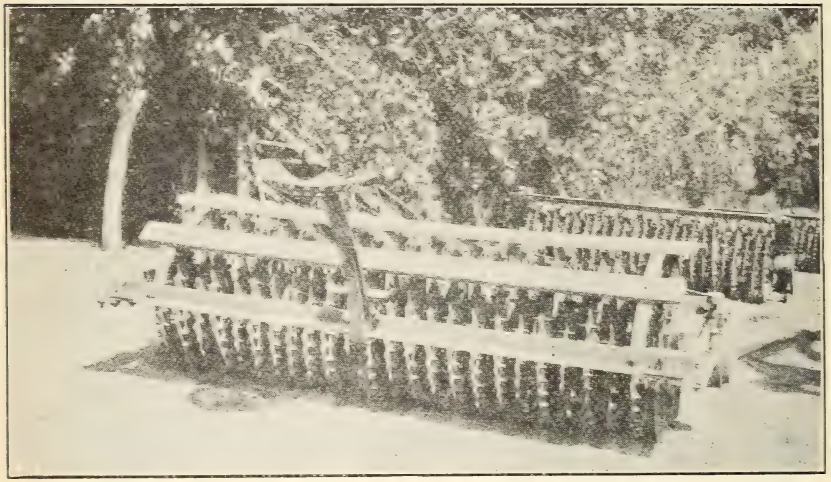

FIG. 7.—A cross-kill roller. The method of construction not only permits this implement to break clods, but it is also well fitted to firm the loose surface and secure the proper texture for a first-class seed bed.

The width of implements used varied from 8 to 12 feet. Four men in the Los Angeles and one each in the Oxnard and Salinas districts did this work with a tractor.

ROLLING.

BEFORE PLANTING.

The type of roller employed in preparing the seed bed ranged from the smooth-drum roller, either wood or steel, to the clod crusher or "cross-kill" (see fig. 7), as it is commonly called. The cross-kill consists essentially of a series of narrow, toothed rings, attached to a shaft or axle. This implement not only breaks up clods and pulverizes the soil, but also serves to pack loose soil. (See Table XI.)

TABLE XI.—*Rolling.*

District.	Number of records.	Per cent of total records.	Acres in beets per farm.		Times rolled.	Hours of labor per acre.		Labor cost per acre.
			Total.	Rolled.		Man.	Horse.	
Before planting:								
Los Angeles	30	37	115.22	96.38	1.24	0.90	3.75	$0.56
Oxnard	11	24	117.36	80.55	1.09	1.01	5.53	.76
Salinas	35	90	93.46	93.46	1.41	1.14	5.51	.79
After planting:								
Los Angeles	78	96	93.16	91.42	1.69	.97	1.95	.39
Oxnard	39	87	66.72	61.59	1.52	.80	1.60	.33

The cross-kill was used exclusively in the Salinas district and on 50 per cent and 72 per cent, respectively, of the farms in the Los Angeles and Oxnard areas. The smooth wood and steel rollers were also used to some extent in preparing the seed bed. The season for rolling extended from October to May. The width of implement ranged from 6 to 12 feet. The labor cost per acre was about the same at Oxnard and Salinas, but considerably lower at Los Angeles.

AFTER PLANTING.

At Los Angeles and Oxnard 96 per cent and 87 per cent, respectively, of the growers rolled after seeding. This work was done when the seedlings were about to push through the ground, and again after thinning. If the rain causes a crust to form before the beets are up, it is customary to break this crust with a roller. Again after thinning it is customary to use a roller to firm the surface soil around the plants.

With the exception of 12 bar rollers in the Los Angeles district, smooth iron and wood rollers were used for this purpose. These rollers were drawn by two-horse teams, and ranged in width from 8 to 16 feet.

HARROWING.

SPIKE-TOOTH HARROW AND SMUDGE.

In addition to the common spike-tooth harrow, the "smudge" harrow was found on many farms in the Los Angeles district. The most common type of smudge consists of two square timbers, usually 4 by 4 inches, and ranging in length from 10 to 12 feet, set parallel about 4 feet apart and securely fastened together by means of cross-pieces, with usually a small platform in the center, on which the operator stands to give the implement additional weight. At regular intervals of about 6 inches steel teeth are driven through the two main timbers. These teeth are shorter than those of the spike-tooth harrow, and are set at an angle of about 45 degrees by placing the

timbers on edge. (See fig. 8.) In passing over the surface of the soil this implement has a grinding, pulverizing action, fills in depressions, and serves to make a smooth, even surface. (See Table XII.)

TABLE XII.—*Harrowing (spike tooth and smudge).*

District.	Number of records.	Per cent of total records.	Acres in beets per farm.		Times harrowed.	Hours per acre.		Labor cost per acre.
			Total.	Harrowed.		Man.	Horse.	
Los Angeles	80	99	95.66	95.66	3.77	3.01	12.80	$1.88
Oxnard	41	91	57.73	55.05	2.49	1.14	7.26	.97
Salinas	39	100	92.72	92.72	4.74	2.00	12.45	1.67

FIG. 8.—Harrowing with a smudge.

The spike-tooth harrow was in almost universal use in the Oxnard and Salinas districts. Smudging was common in the Los Angeles district. On 95 per cent of the farms in the Oxnard and Salinas districts the spike-tooth was used while 95 per cent of the men in the Los Angeles district reported the use of the smudge.

The 1-man-4-horse crew was most in evidence in the Los Angeles district. Sixty-five per cent reported a crew of that size, while 14 per cent, 33 per cent, and 74 per cent in the Los Angeles, Oxnard and Salinas districts, respectively, reported the use of the 1-man-6-horse crew (see figs. 9 and 10). The 1-man-8-horse crew was reported on 42 per cent of the farms in the Oxnard district.

The spike-tooth used consisted of from two to four sections and varied in width from 10 to 20 feet.

THE CYCLONE HARROW.

The cyclone harrow was found on five farms in the Los Angeles area and on four at Oxnard. This implement consists of a heavy

FIG. 9.—Typical crew harrowing with a spike-tooth.

plank armed with steel knives which extend to the rear and downward. These knives are bent toward the center of the implement

FIG. 10.—Spike-tooth harrowing with a crew of one man and six horses. Two horses are hitched directly to the harrow, while four horses are worked abreast in front of them.

from either side, and they run just below the surface and cut off weeds. This implement pulverizes the soil quite effectively and creates a dust mulch on the surface.

The cyclone harrows ranged in width from 8 to 10 feet, and were used for a period extending from December to April. In the Oxnard area the total beet acreage was covered on the farms using this implement, while in the Los Angeles area only 32 per cent of the acreage per farm was covered.

SPRING-TOOTH HARROW.

This implement was found only in the Los Angeles and Oxnard areas, its purpose being served by the chisel in the Salinas area. The spring-tooth harrow stirs the soil to a greater depth than does the cyclone or spike-tooth, brings clods to the surface and pulverizes the soil. Like the cyclone, the spring-tooth, where operated, was used on the total beet acreage per farm in the Oxnard district (see Table XIII) but on only 80 per cent of the Los Angeles acreage per farm.

TABLE XIII.—*Harrowing (spring-tooth).*

District.	Number of records.	Per cent of total records.	Acres in beets per farm.		Times harrowed.	Hours of labor per acre.		Labor cost per acre.
			Total.	Harrowed.		Man.	Horse.	
Los Angeles	22	27	99.86	79.73	1.2	1.51	8.01	$1.10
Oxnard	25	56	44.36	44.36	1.6	1.25	8.48	1.11

The spring-tooth harrows used consisted of from 2 to 4 sections and ranged in width from 6 to 12 feet. Its use extended over a period of from December to April. Four-horse outfits were used on 32 per cent of the farms in the Los Angeles district. On 72 per cent of the Oxnard farms 8-horse outfits were used.

FLOATING AND LEVELING.

The float or plank drag was used on a relatively small number of farms, ranging from 11 per cent in the Los Angeles to 46 per cent in the Salinas district. (See Table XIV.) This implement is an excellent tool to break up small clods and create a smooth, even surface. It is generally one of the last implements to be used in preparing the seed bed and is usually run over the ground a few days before planting.

TABLE XIV.—*Floating and leveling.*

District.	Number of records.	Per cent of total records.	Acres in beets per farm.		Times over.	Hours of labor per acre.		Labor cost per acre.
			Total.	Floated.		Man.	Horse.	
Los Angeles	9	11	122.11	122.11	1.6	1.58	10.69	$1.39
Oxnard	16	36	71.88	47.19	1.1	.90	6.09	.80
Salinas	18	46	95.00	81.39	1.4	.97	5.73	.77

The width of the floats used varied from 8 to 14 feet. The size of implements depends somewhat upon the horse power available. For all districts studied 43 per cent used a 1-man-8-horse crew, 35 per cent a 1-man-6-horse crew, and 16 per cent a 1-man-4-horse crew.

On fields where irrigation is necessary a homemade implement, known as a level, is used to make the surface of the ground level and to facilitate an even distribution of water over the land. (See fig. 11.)

PLANTING.

The seeding was done from December 1 to June 1, the time varying somewhat according to locality. The records for the Los Angeles district do not indicate any definite planting period. There the seeding extended from December to May, with 39 per cent of the men

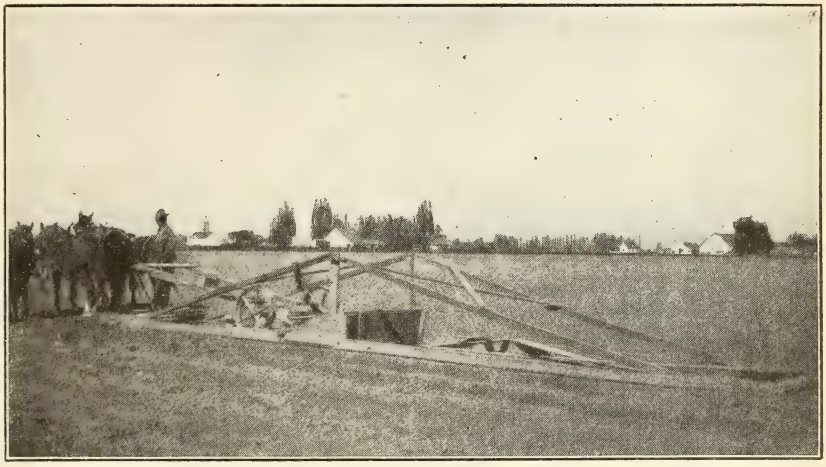

FIG. 11.—Leveling. This operation is especially important on fields that are to receive irrigation.

reporting the work as being performed in March or April. In the Oxnard area 44 per cent planted in December or January and in the Salinas area 80 per cent seeded in April or May. (See Table XV.)

TABLE XV.—*Planting.*

District.	Number of records.	Acres in beets per farm.	Times planted.	Hours of labor per acre.		Labor cost per acre.
				Man.	Horse.	
Los Angeles	81	95.14	1.25	1.15	2.34	$0.46
Oxnard	45	62.47	1.05	.93	2.12	.41
Salinas	39	92.72	1.13	1.12	2.24	.46

In every district some replanting was necessary. Forty-eight men in the Los Angeles district and seven and sixteen, respectively, in

the Oxnard and Salinas districts, replanted a portion of their acreage. In most cases reseeding is made necessary by rains causing the surface of the soil to cake so that the young beet seedlings are unable to push through. Sometimes, on sandy soil, wind storms blow the seed out, and sometimes excessive alkali prevents good germination.

The average rate of seeding for the several districts showed some variation. Approximately an average of 18½ pounds per acre was required in the Los Angeles district, while an average of 16 pounds and 14 pounds, respectively, was used in the Oxnard and Salinas districts.

The seed is planted in solid rows to insure a good stand. Later, after the young plants have pushed through to the surface, they are thinned out to a suitable distance. This operation will be discussed under a separate heading.

Special beet drills were used. These were of two sizes, the 4-row and the 8-row, and they were usually equipped with press wheels, which exert a uniform pressure on the drill row, firming the soil and aiding in retention of sufficient moisture to insure quick germination of the seed. The 8-row drill was not very common, only two being reported in the Los Angeles district and eleven in the Oxnard district. None were reported in the Salinas district. The 8-row outfit requires four horses to operate, while 4-row drills are operated with 2-horse teams. On farms in the Oxnard area, when no replanting was done, the average labor cost of planting with an 8-row drill was 18 cents per acre less than on farms where 4-row drills were used.

In the Los Angeles area the seed was planted in rows 18 inches apart on 38 farms and 16 inches apart on 43 farms. All of the Oxnard growers planted in 18-inch rows, while in the Salinas district 20-inch rows were reported on all farms except four, where the 18-inch row was used.

CULTIVATING.

The cultivating period in the Los Angeles and Oxnard districts extended from about February 15 to July 15. On Salinas farms the work was done mainly in May, June, and July. The first cultivation precedes blocking and thinning. The cultivator is usually equipped with knives or "duck feet" for killing weeds, and a shallow cultivation is given. Subsequent cultivations are usually deeper. It is customary to run the cultivator at frequent intervals until the beets are so large that it is impossible to follow the row.

On the Los Angeles and Oxnard farms the ground was cultivated from three to seven times (Table XVI), while in the Salinas district it was covered from one to three times. Twelve other men in the Salinas district, whose records do not figure in the table, had culti-

vating done under contract by Japanese, the horses and implements being provided by the grower.

TABLE XVI.—*Cultivating.*

District.	Number of records.	Per cent of total records.	Acres in beets per farm.		Times cultivated.	Hours of labor per acre.		Labor cost per acre.
			Total.	Cultivated.		Man.	Horse.	
Los Angeles	81	100	95.20	95.20	4.72	4.54	9.08	$1.82
Oxnard	45	100	62.47	62.47	3.73	3.78	7.56	1.55
Salinas	26	67	85.62	85.62	1.50	1.47	2.94	.60

There is no apparent reason for the relatively few cultivations given on the Salinas farms. It would seem that somewhat more intensive cultivation throughout the growing period would be necessary to control weed growth effectively.

In all districts special 4-row riding cultivators and 2-horse teams were used.

HAND LABOR.

The hand labor includes such work as thinning, weeding, hoeing, pulling, topping, and loading. These operations are done on a contract basis. In some cases all of the hand labor is handled under one contract. Some growers use two contracts, the first taking care of the thinning, weeding, and hoeing and the second dealing with the pulling, topping, and loading.[1]

[1] A contract embracing all hand labor is given herewith for the purpose of illustration:

This agreement, made and entered into between ———, party of the first part, and ———, party of the second part,

Witnesseth: That, for and in consideration of the covenants hereinafter contained on the part of the first party, the party of the second part agrees, at different times and in the manner prescribed by the party of the first part to thin out, hoe, clean between the beets in the row and keep said beets free from weeds until they are harvested, and top and load said beets into wagons, a portion or portions, to be assigned hereafter, of sugar beets planted by party of the first part on land described as follows:————————

The party of the second part further agrees as follows:

1. To commence thinning beets within 24 hours after verbal notice given by the party of the first part, and to complete the thinning before the said beets shall have four leaves well developed.

2. To thin out beets to ——— inches apart in the rows and to leave no more than one beet to each ——— inches in the row. While thinning to hoe, with hand hoe, two inches on each side of the beet row as well as between the beets in the row so that the soil will be thoroughly cultivated and all the weeds totally destroyed.

3. To do the thinning and weeding above mentioned in proper and farmerlike manner and to the satisfaction of the party of the first part.

4. Within 24 hours after verbal notice given by the party of the first part to pull, shake free from adhering earth, top and load beets into wagons; beets to be topped cleanly and squarely with one blow of the knife at base of bottom or last leaves. Beets will be carefully plowed out by party of the first part, but any beets not loosened by the plow shall be dug out by party of the second part.

5. When beets are plowed, party of the second part shall top and load into wagons as many tons of beets each day as party of the first part shall be required to deliver to the sugar factory.

6. Party of the second part agrees to personally superintend all the work above described and to have it done to the satisfaction of the party of the first part.

It is further agreed that if the party of the second part shall neglect or refuse to perform any of the above operations at the time set, or in the manner prescribed by the party of the first part, then the party of the first part shall have the right and option to cancel this contract, and any money that may have become due to the party of the second part on account of thinning, hoeing, topping, or loading done shall be forfeited to the party of the first part, or it shall be optional with the party of the first part to

IRRIGATION.

In the Los Angeles and Salinas areas irrigation is frequently necessary in the production of sugar beets. Usually one irrigation is required.

Different methods are employed in applying the water. In the Los Angeles area the water is pumped from wells and forced through portable galvanized iron pipes (see figs. 12 and 13). These pipes, 10 to 12 feet long, with a diameter of 8 to 10 inches, are fitted together and stretched across the beet field. The entire field is covered by moving them from one place to another, the land adjacent to the pumping plant being watered last. In a number of cases underground concrete pipes are used to carry the water from the well out into the field, where a number of outlets are provided for attaching the galvanized surface pipe. This method requires less surface pipe than the first, and less work in moving pipes from one place to another. It is a comparatively expensive method, however, requiring a large investment in equipment.

This system of irrigation is known as the flood system and the water is applied to the growing crop usually during the latter part of July or the first part of August.

In the Salinas area winter irrigation is usually practiced. In most instances the water, as well as the labor for applying it to the land, is furnished by the sugar company at a flat rate of $3.75 an acre. The water used is the factory waste water, and it is applied in October

put in other men to complete any work unfinished or neglected by the party of the second part and charge the cost of such labor to the party of the second part.

In consideration whereof the party of the first part agrees to pay to the party of the second part for thinning, hoeing, weeding, topping, and loading beets, as follows:

Tons per acre.	Price per acre.	Price per ton.	Tons per acre.	Price per acre.	Price per ton.
20	$16.50	$0.825	11	$14.25	$1.295
19	16.25	.855	10	14.00	1.400
18	16.00	.890	9	13.75	1.528
17	15.75	.926	8	13.50	1.687
16	15.50	.969	7	13.25	1.893
15	15.25	1.017	6	13.00	2.167
14	15.00	1.071	5	12.75	2.550
13	14.75	1.135	4 or under	12.50	3.125
12	14.50	1.208			

Fractions of tons per acre in proportion.

The tonnage per acre to be determined for each field upon the net weight of the beets received by the sugar factory.

During the course of the work the first party agrees to pay the second party a sum not exceeding 80 per cent of the amount covering work already done, the balance to be paid when the work specified in this contract shall have been completed to the satisfaction of the first party.

The sum not to exceed 80 per cent of the amount covering the work already done is to be based on $——— per acre for thinning, $——— per acre for the first hoeing, and $——— per acre for the second hoeing, and the balance for topping and loading, according to schedule of prices stated in this contract.

Witness our hands and seals this ——— day of ——— 19—.

Witness:

_____ _____ [SEAL.]

_____ _____ [SEAL.]

and November. The irrigation may come before the land is plowed, or after the plowing, depending on the condition of the soil. It is

FIG. 12.—Pipes used for irrigating. They have been distributed across the field, but have not been connected in a continuous line.

frequently advisable to put the water on the land before plowing, since this practice greatly facilitates that operation.

Occasionally it is necessary to irrigate the beets after they are up. When this is done river water is used, being pumped through the same system as is used for the factory waste water, at the same

FIG. 13.—Irrigating sugar beets.

charge per acre. At this time the flood system is used without the use of surface pipe.

A few growers have their own water systems and pump the water from wells on the farm. In these cases also the land is flooded, but no surface pipe is used.

CHECKING LAND.

Where winter irrigation is practiced, considerable labor is required in preparing the land for the water. The land is checked—that is, a network of small levees is thrown up which serves to hold the water on the land until it has time to soak in. A strip several furrows wide is plowed across the field where each levee is to be made and the loose earth is ridged by a special implement called a "V." (See fig. 14.) When a "V" is not available a Fresno, or a small scraper, is used to ridge the earth.

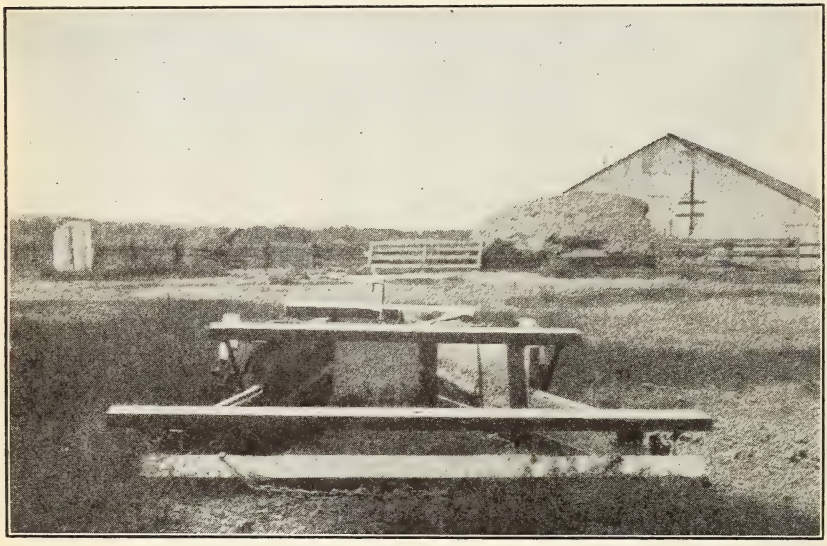

FIG. 14.—A "V." This implement is used to check the land for winter irrigation.

About 62 per cent of the growers at Salinas checked the land for irrigation. There were only two instances where the land was rechecked. This was done to irrigate for replanting. This operation occurred from September to June. An average crew of 1.5 men and 7.2 horses was used and 0.93 man hours and 3.96 horse hours were required per acre at an average cost of 40 cents per acre.

Frequently these levees are permanent and require only a small amount of labor each year to keep them in repair. Sometimes, however, the levees are harrowed down after the irrigation and new ones are constructed annually.

About 30 per cent of the growers who checked the land for irrigating made it the practice to break up or level the levees before the beets were planted. A plow, harrow, and roller were used in this

operation. An average crew of 1.1 men and 5.4 horses consumed 0.33 man hours and 1.56 horse hours per acre at an average cost of 23 cents per acre.

TABLE XVII.—*Irrigating.*

District.	Number of records.	Per cent of total records.	Acres in beets per farm.		Man hours per acre.	Labor cost per acre.
			Total.	Irrigated.		
Los Angeles	53	65	104.67	87.26	6.57	$1.31
Salinas	9	23	97.67	73.44	5.04	1.06

Irrigation was not practiced at Oxnard, and only nine growers at Salinas reported labor on this operation. (Table XVII.) However, this number represents only the growers who practiced irrigation, and not those who had it done on contract. In all, 24 growers, or 62 per cent, irrigated, 56 per cent of which paid a contract rate of $3.75 per acre. The percentage of total number of records in both areas where irrigation was practiced is fairly uniform. On the farms where irrigation was practiced, 83 per cent of the beet land was irrigated in the Los Angeles area, while at Salinas 92 per cent of the beet land received an application of water.

At Los Angeles the beets were irrigated from March to August. At Salinas three growers irrigated the beets from June to August, two men irrigated only for replanting beets, fourteen growers irrigated before plowing, while five made the application after the land was plowed.

The time required per acre, as well as the cost, does not vary greatly in the two regions. At Salinas the estimates are slightly lower than in the Los Angeles area. The average crew at Salinas was 2.7 men, while at Los Angeles the crew was only 1.6 men.

A twofold benefit is derived from the factory waste water. In addition to furnishing moisture that is usually sufficient to bring the crop to maturity, the water returns to the soil some of the mineral constituents of the sugar beet. It has been found that for every 100,000 parts of water there are 80 parts residue. This plant food is in an available form and can be readily taken up by the sugar beet.

LIFTING.

The degree of maturity of the crop determines the time to start the work of lifting or plowing out the sugar beet in these areas. The time that the beet reaches the proper stage varies according to weather conditions, time of planting, etc., and is generally determined for the grower by a sugar test made by the sugar-factory representative.

In the Los Angeles area this period extended from July 20 to December 1, in the Oxnard district from July 15 to November 10, and on Salinas farms from September 1 to November 25. (Table XVIII.)

TABLE XVIII.—*Lifting.*

District.	Number of records.	Per cent of total records.	Acres in beets per farm.		Hours of labor per acre.		Labor cost per acre.
			Total.	Lifted.	Man.	Horse.	
Los Angeles	66	81	91.92	89.52	4.19	16.72	$2.51
Oxnard	37	82	46.68	46.68	3.63	23.77	3.14
Salinas	39	100	92.72	92.72	4.45	26.37	3.57

FIG. 15.—Harvesting sugar beets with a crotch lifter that is operated by a crew of one man and four horses.

There are two general types of implement used in doing this work, viz, the crotch lifter and the side lifter. (See fig. 15.) The crotch lifter has double prongs which run on both sides of the row, while the side lifter has single points on the ends of long, thin, cutting blades, the most common size being the one-row implement with but one point. This is called a "side lifter" because the point runs at the side of the row. The crotch type lifts only one row, while side lifters are made to lift from one to four rows at a time. Side lifters are universally used when tractor power is employed. (See fig. 16.) The size of the lifter used depends on the horsepower of the tractor. Both side and crotch lifters were used in the Los Angeles district. On Salinas farms crotch lifters were used exclusively, while on farms in the Oxnard district the side lifter was the universal type.

In the Los Angeles district 4-horse outfits were employed on 48 per cent of the farms and 3-horse outfits on 19 per cent. Six-horse outfits were found on 44 per cent of the farms in the Oxnard and on 95 per cent in the Salinas area.

In addition to the work shown in the table, 13 men in the Los Angeles and 5 in the Oxnard area contracted the lifting at a rate of $3 to $3.50 per acre. In some cases this work was done by steam power. (See fig. 17.)

Four men at Los Angeles and four at Oxnard did the work of lifting with their own tractors. The amount of work accomplished per day varied from 4 to 10 acres.

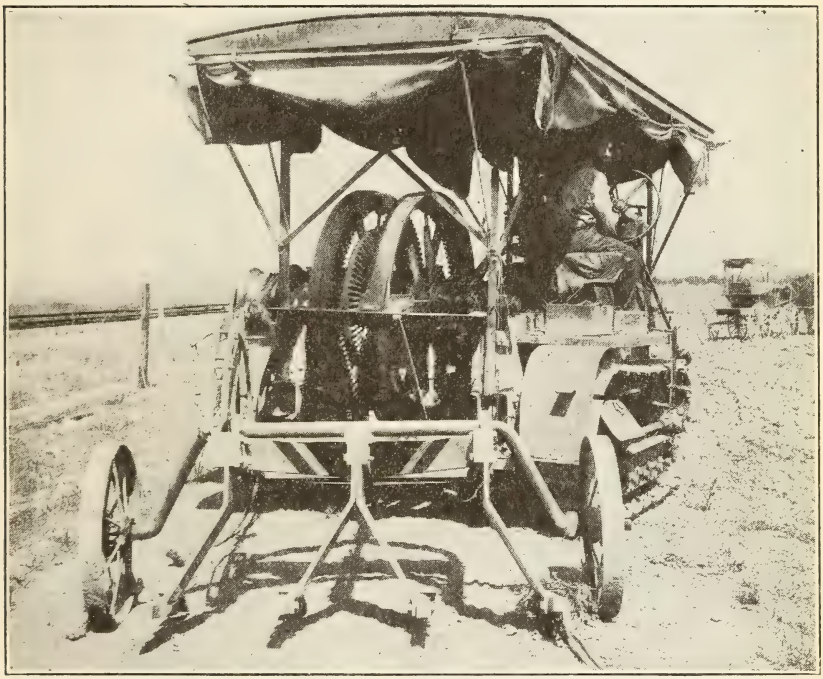

FIG. 16.—A 4-row beet harvester (side lifter) that is operated by a gasoline tractor.

TOPPING.

Topping is classified as contract labor, and has been considered under the heading "Hand labor." (See fig. 18.)

HAULING.

The sugar beet is loaded by the contract beet workers into strong, well-built beet boxes, either with forks or by hand. (See figs. 19 and 20.) From the field they are hauled either to a loading station where they are loaded into cars, or directly to the sugar factory beet dump. Upon arrival at the loading station or factory, as the

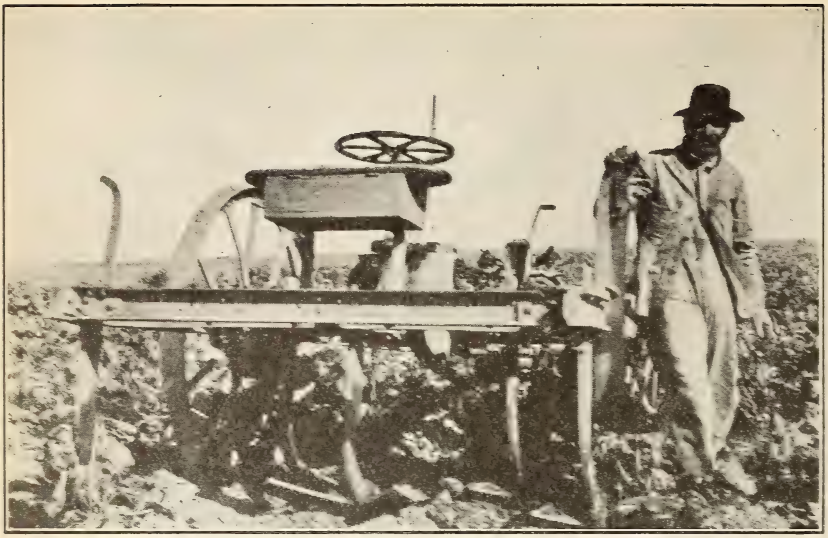

FIG. 17.—A beet harvester that is operated by steam power through the use of a steel cable. Two engines are required in this case, one at each end of the field.

FIG. 18.—Topping sugar beets. A small hook attached to the end of the knife enables the worker to lift the loosened beet out of the soil. He then takes hold of the root with his left hand and cuts off the top.

FIG. 19.—Loading by hand and hauling sugar beets from the field. Observe the net that is used on the wagon rack. At the dump the wagon is unloaded in a single operation by lifting this net.

FIG. 20.—Loading sugar beets with forks.

case may be, a representative sample is taken and weighed as it comes from the load. Then all dirt is removed, the sample is retopped when necessary, and the clean beets are weighed a second time. The difference in weight between the beets before and after cleaning determines the percentage of tare.

Eighteen men in the Los Angeles and five in the Oxnard district hired all of the hauling done at a contract rate of from 35 to 55 cents per ton, depending on the distance hauled. (See Table XIX.) In the Salinas area the hauling was all done by the farmers themselves. The number of tons of beets hauled at one trip ranged from 3 to 6

FIG. 21.—Hauling sugar beets with wagon and trailer. The crew consists of one man and eight horses. This is a common practice in the beet-producing districts of California.

tons for the single wagon to 7 to 10 tons where a trailer wagon was used.

TABLE XIX.—*Hauling.*

District.	Number of records.	Per cent of total records.	Acres in beets per farm.		Distance hauled.	Hours of labor per acre.		Labor cost per acre.
			Total.	Sold.		Man.	Horse.	
					Miles			
Los Angeles	63	78	109.29	108.90	1.20	5.80	31.36	$4.30
Oxnard	40	89	63.30	63.30	1.76	4.66	31.00	4.08
Salinas	39	100	92.72	90.15	1.06	4.99	30.74	4.12

The season for hauling extended from July to December. The 1-man-6-horse and 1-man-8-horse crews were the ones most in evidence, 50 per cent of the former and 24 per cent of the latter being reported. (See figs. 21 and 22.)

The average distance to the loading station was 1.33 miles. The shortest average distance hauled, 1.02 miles, was found in the Salinas district, and the longest, 1.76 miles, in the Oxnard area. (Table XX.) One hundred and forty-two men reported hauling with horsepower, and of this number 47 per cent hauled less than 1 mile and 13 per cent more than 2 miles. Forty per cent hauled an average of 1.56 miles. Those who hauled an average distance of 0.67 of a mile did so at an average cost of 14 cents per ton less than the men who hauled over 2 miles, or an average of 2.83 miles. (See figs. 23 and 24.)

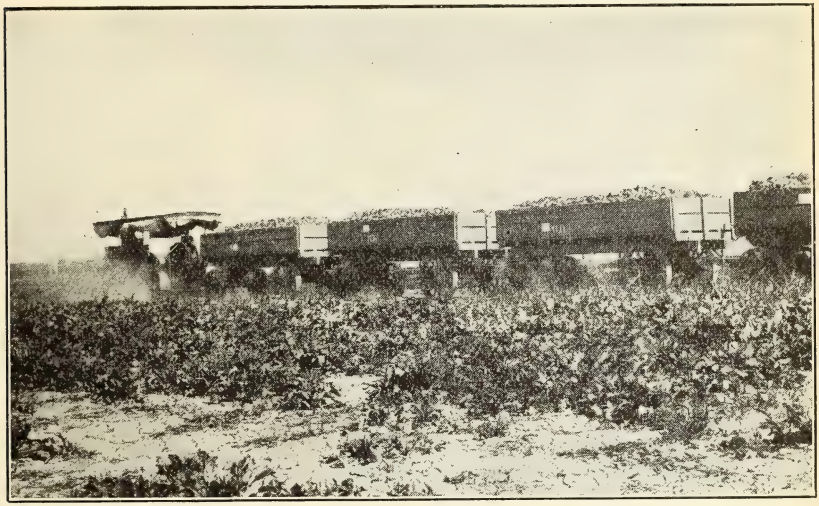

FIG. 22.—Hauling sugar beets from field to factory with a tractor and a train of four wagons.

TABLE XX.—*Cost of hauling as influenced by the distance hauled.*

Distance.	Average distance.	Number of records.	Per cent of total records.	Labor cost per ton.
	Miles			
1 mile and under	0.67	66	47	$0.26
1 to 2 miles, inclusive	1.56	57	40	.32
Over 2 miles	2.83	19	13	.40

VARIATIONS IN FIELD PRACTICE.

While standard methods of handling a crop may be followed quite closely by many growers in a given district, certain variations are inevitable because of differences in soil, or in the previous treatment of the field, or in the time when the work of preparation is begun.

Factory methods can not always be followed in producing a crop of sugar beets or any other crop. In districts where the weather conditions do not interfere seriously with field operations, the plowing,

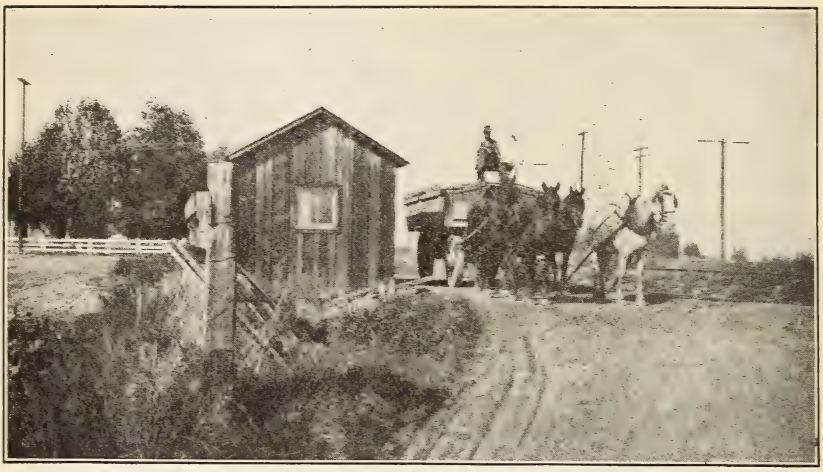

FIG. 23.—Weighing sugar beets at point of delivery.

harrowing, etc., may be done according to a previously planned schedule, but even in such cases variations in field practice are bound to exist. Some of these features are illustrated in Tables XXI, XXII,

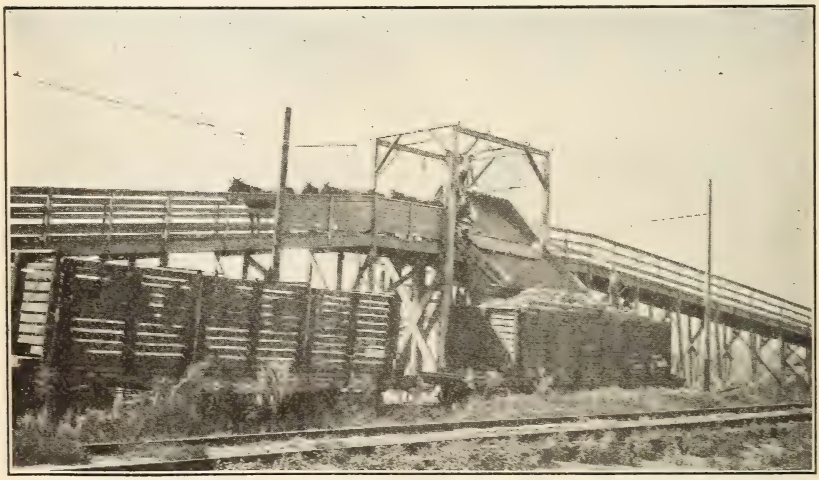

FIG. 24.—Delivering sugar beets to cars at a typical loading station.

and XXIII, tabulated from the records of 10 selected farms from each district.

TABLE XXI.—*Variations in farm practice (Los Angeles district).*

Operation.	Farm No. 1.	Farm No. 2.	Farm No. 3.	Farm No. 4.	Farm No. 5.	Farm No. 6.	Farm No. 7.	Farm No. 8.	Farm No. 9.	Farm No. 10.
	Times over.									
Plowing	1.2	1	1	1	1	1	1		1	1
Disking						.4		1		
Chiseling								1		
Harrowing:										
Cyclone			.6							
Spike	4	6	3	3	3	4	3	2	6.6	3
Spring	.2				1		1			1
Rolling	.2	3	1	2		1				2
Planting	1.2	1	1.2	1	1.1	1	1	2	1.8	1.5
Rolling beets	.3	1	1	2	3	2			.5	1.
Cultivating	4	4	4	5	5	3	4.5	4	4	7
Irrigating	1	.7	1	1	1.8	1			1	
Blocking and thinning	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.
Hoeing:										
First	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.
Second	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.
Topping and loading	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.
Lifting	Con.	1	1	1	1	1	1	1	1	Con.
Hauling	1	1	1	1	Con.	1	1	Con.	1	1
Scraping		1								
Manuring[1]	.4		.1	.2		.1	.1		.2	.04
Hours per acre:										
Man	25	26	33	43	24	28	17	17	42	25
Horse	72	98	100	136	63	105	94	58	130	109
Yield per acre	15.3	22.0	15.8	16.1	13.3	17.2	13.9	12.0	18.6	19.2
Cost per acre	$74.55	$68.85	$76.77	$74.28	$67.13	$69.48	$64.92	$65.41	$76.11	$74.69

Average cost per acre for the district $67.11

[1] It will be seen that fractional numbers are used under the operation manuring. These numbers indicate that only a part of the beet land was manured. For instance, Farm No. 1 in the Los Angeles district applied manure to four-tenths of the sugar-beet acreage. No. 3 treated one-tenth of the beet acreage with manure, while No. 4 covered two-tenths. Fractions occurring under other operations should be interpreted in the same manner.

TABLE XXII.—*Variations in Farm Practice (Oxnard District).*

Operation.	Farm No. 1.	Farm No. 2.	Farm No. 3.	Farm No. 4.	Farm No. 5.	Farm No. 6.	Farm No. 7.	Farm No. 8.	Farm No. 9.	Farm No. 10.
	Times over.									
Plowing	1	2	1	1	2	1	2	1	1	1
Disking		1		2				2		
Chiseling										
Floating	1		1	1	1					2
Harrowing:										
Cyclone									1	
Spike	1	2	4	2	4	3	2	2	4	4
Spring	3	2	1				1	1		3
Rolling:										
Crosskill		1			1					
Ring									1	
Fertilizing										
Planting	1.03	1	1	1	1	1	1	1	1	1
Rolling beets	1	2	2	1	1				2	3
Cultivating	4	4	4	4	5	5	3	4	3	3
Blocking and thinning	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.
Hoeing	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.
Topping and loading	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.
Lifting	1	1	1	1	1	1	1	1	1	1
Hauling	1	Con.	1	1	1	1	1	1	1	1
Manuring	.1			.2	.1	.2	.3	.2	.6	
Hours per acre:										
Man	12	29	19	16	19	25	20	19	30	22
Horse	79	86	122	107	117	109	121	102	100	119
Yield per acre	10	6.5	8	9	8.25	11	8	12	12	16.3
Cost per acre	$53.34	$51.41	$52.37	$55.92	$54.88	$55.54	$59.00	$56.34	$57.83	$60.01

Average cost per acre for the district $54.88

TABLE XXIII.—*Variations in Farm Practice (Salinas District).*

Operation.	Farm No. 1.	Farm No. 2.	Farm No. 3.	Farm No. 4.	Farm No. 5.	Farm No. 6.	Farm No. 7.	Farm No. 8.	Farm No. 9.	Farm No. 10.
	Times over.									
Plowing	1	1	1.7	1	.....	1	1	1	1	1
Disking	.....	.....	.....	.....	.....	2	.....	.....	1	.....
Floating	.....	2	.....	.....	1	2	.....	.....	.....	1
Chiseling	1.5	1	1	1	1	2	.5	1.3	1	1
Harrowing (spike)	3.5	6	6	3	2	5	3	10	5	5
Rolling	1	1	2	1	1	2	1.5	1.3	1	2
Planting	1.5	1.1	1	1	1	1	1.5	1.3	1	2
Cultivating	.....	1	1	1	1	2	3	2	1	1
Checking land	.5	1	.....	1	.....	.5	.....	.....	1	1
Irrigating	Con.	Con.	.....	1	.....	.5	.....	.....	Con.	1
Leveling levees	.....	.....	.....	.....	.....	.....	.....	.....	1	1
Blocking and thinning	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.
Hoeing:										
First	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.
Second	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.
Topping and loading	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.	Con.
Lifting	1	1	1	1	1	1	1	1	1	1
Net man	.....	.....	1	1	1	1	1	1	1	1
Hauling	1	1	1	1	1	1	1	1	1	1
Scattering tops	1	.....	.....	.....	.....	1	1	.....	.....	.....
Manuring	.1	.....	.....	.03	.....	.01	.....	.1	.02	.1
Hours per acre:										
Man	14	24	24	22	17	32	20	25	19	30
Horse	80	142	107	85	85	149	122	132	93	122
Yield per acre	16.50	17.70	15.00	18.50	14.00	9.00	20.50	18.00	14.80	13.00
Cost per acre	$56.56	$67.48	$60.78	$67.81	$54.88	$63.86	$74.21	$69.72	$63.00	$73.96

Average cost per acre for the district $66.45

Some of the operations that are mentioned in these three tables were not common to all districts. On many farms it was customary to give the land one plowing. However, in several cases the early fall plowing was followed by winter plowing. The chisel was used on only one of the ten Los Angeles farms, on none in the Oxnard group, and on all farms in the Salinas group. There was considerable variation in the number of times the fields were covered with the spike-tooth harrow. This was also true with cultivation.

COST OF PRODUCING SUGAR BEETS.

The more important factors which enter into the cost of producing sugar beets are labor, interest on land or rental, seed, water, taxes and insurance. In terms of money these factors are variable. As the supply of farm labor decreases the labor cost increases. There is a corresponding increase in the cost of farm implements. Increased labor costs result also in an increase in the cost of materials. If the land valuation advances or the rate of interest increases, so also does the interest on the land investment become greater. However, such fundamental factors as hours of man labor, hours of horse labor, pounds of seed, hours use of equipment and tons of manure do not fluctuate appreciably. Comparisons of amounts of labor and materials required in each area give the true relationship

of farm practices. Thus, though the values of the several items in dollars and cents have increased since these records were obtained, the amounts of labor and material used have not changed, and the actual cost of production for a given region in a given season can be ascertained by substituting current prices for those that prevailed when this study was made. It should be borne in mind that the cost figures given herewith are presented solely for the purpose of comparison.

The computations are made to apply to the entire beet acreage. Thus all averages are weighted, and the cost per acre in the respective areas represents the cost per acre of producing 7,711.5 acres of beets in the Los Angeles district, 2,811 acres in the Oxnard area, and 3,616 acres at Salinas.

LABOR.

As has been previously stated, the production of sugar beets necessitates a great amount of both man labor and horse labor. A considerable portion of the man labor is crowded into two distinct periods. The first period covers blocking and thinning, and hoeing, while the other comes at the harvest time, when the pulling, topping, loading, and hauling are done. So much labor is necessary during these periods that extra laborers must be hired to do the work.

It is the general practice to hire most of this labor on a contract basis, paying a stipulated sum per acre or per ton. Such labor is frequently called "contract labor." Sometimes the same group of laborers will contract for all the hand work. This is the general practice in the Salinas area. In other sections there are sometimes two groups of workers. The first contracts the blocking and thinning, and hoeing, while the second takes care of the pulling, topping, and loading.

The number of acres of beets that can be grown on the farm depends on the available supply of labor to do the contract work. In years when farm labor is scarce, considerable difficulty has been encountered in getting the crop harvested.

There is very little difference in the labor cost per acre between the Los Angeles district and the Oxnard district (Table XXIV). The labor cost at Salinas exceeds the labor cost in the other regions, but when reduced to the basis of cost per ton, the labor cost at Oxnard is the largest. The difference is due entirely to the factor of yield. The smallest yield per acre, 9.53 tons, was realized in the Oxnard district. The labor cost alone ranged from $2.13 to $3.02 per ton, or $28.73 to $35.64 per acre. (See Table XXIV.)

TABLE XXIV.—*Labor costs.*

District.	Number of farm records.	Total acres in beets.	Labor cost per acre.	Labor cost per ton.
Los Angeles	81	7,711.5	$30.93	$2.13
Oxnard	45	2,811.0	28.73	3.02
Salinas	39	3,616.0	35.64	2.29

MATERIALS.

Under materials come the items of seed, manure, and water. The cash paid out for materials as well as the estimated values of materials produced on the farm were used in computing the costs.

SEED.

Beet seed is furnished by the sugar companies and advanced to the farmer. The seed is paid for out of the first delivery of beets to the factory. No interest is charged to the farmer on the money invested in the seed during this period.

In the Los Angeles and Oxnard districts, the beet seed cost 12 cents per pound, while in the Salinas area the farmer was charged 16 cents a pound. The rate of seeding also affects the cost per acre. At Los Angeles the average rate of seeding was 20.7 pounds per acre, at Oxnard 16.6 pounds, and at Salinas 14.6 pounds.[1] It will be seen that the low cost at Oxnard is due to the lower rate of seeding (Table XXV), while the high cost at Los Angeles results from a high rate of seeding. In the Salinas district the high cost per acre is due to the higher cost per pound of beet seed.

TABLE XXV—*Cost of materials.*

District.	Number of farm records.	Cost per acre.			Total cost of materials per acre.	Cost of materials per ton.
		Seed.	Manure.	Water.		
Los Angeles	81	$2.48	$0.67	$0.55	$3.70	$0.25
Oxnard	45	1.99	.89	.....	2.88	.30
Salinas	39	2.34	.27	1.50	4.11	.26

MANURE.

The manure charge deals only with the manure produced by the stock kept on the farm. Neither commercial fertilizer nor green manures are used to any extent in any of the areas studied.

An estimate of the value per ton of the manure in the barnyard was obtained from the grower. By multiplying this figure by the

[1] This includes seed for replanting if charged to the grower.

number of tons of manure applied per acre the actual cost per acre covered was computed.

Comparatively speaking, very little manure was used. At Los Angeles about 6 per cent of the beet land was manured, in the Oxnard district 9 per cent, and at Salinas only 2¼ per cent. The cost of manure per acre of beets grown is found by dividing the total value of the manure applied by the entire beet acreage. Thus the extremely low costs per acre are shown, since but a small percentage of the sugar beet acreage received an application of manure.

WATER.

In the Los Angeles area and in the Salinas district the sugar beet is frequently grown under irrigation. At Oxnard only one man was interviewed who followed this practice. No favorable report was obtained regarding irrigation in this area.

At Los Angeles the beets are irrigated by pumping water from wells. Here the principal charge, exclusive of equipment, is for fuel and lubricating oil. The equipment charge is included under the machinery cost. About 62 per cent of the beet land was irrigated in this district.

At Salinas the greater portion of the irrigation is done by the sugar company. A flat rate of $3.75 per acre is charged. A few growers who own the land they farm have pumping plants and irrigate by pumping the water from wells. About 50 per cent of the growers either irrigated their beet land or hired it done. Since the cost of labor required to irrigate is included in most of the records for Salinas, the cost per acre for this district is considerably greater than for Los Angeles.

The highest cost per acre for materials was reported at Salinas, the lowest at Oxnard. As has been indicated, much of the difference in the cost in favor of Oxnard is due to the fact that the farmers of that district did not irrigate their beet land. Figured on the ton basis, the low yield per acre gives the highest cost per ton to Oxnard. The costs in the other two areas are approximately the same.

OTHER COST ITEMS.

In considering the cost of producing any farm crop, there are a number of items of expense which apply to more than one enterprise on the farm and some that have to deal with the whole farm as a unit. Such items as insurance, taxes, interest on the land investment, machinery, and miscellaneous expense come in this group of costs. Table XXVI shows the average cost per acre of these different items, the total cost per acre of the group, and the cost per ton for the three areas.

INSURANCE AND TAXES.

The sugar beet must stand a share of the farm insurance and taxes. This charge is greater on farms owned by the operator than on rented land, since the owner pays taxes on the assessed valuation of the land, while the tenant pay taxes only on his personal property.

TABLE XXVI.—*Other costs.*

District.	Number of farm records.	Total beet acreage.	Cost per acre.				Total cost per acre.	Cost per ton.
			Insurance and taxes.	Interest and rent.	Machinery.	Miscellaneous expense.		
Los Angeles	81	7,711.5	$1.98	$26.66	$2.80	$1.04	$32.48	$2.24
Oxnard	45	2,811.0	1.97	17.85	2.50	.95	23.27	2.44
Salinas	39	3,616.0	1.04	21.22	3.25	1.19	26.70	1.71

On owned farms taxes and insurance were charged against the beet crop according to the percentage the investment in the beet land was of the total farm real-estate investment. (See Table XXVI.) On tenant farms the proportion of this expense chargeable to the sugar beet was determined by the relative importance of the sugar-beet enterprise. In the latter case the charge per acre was always small.

Several factors affect the average charge for these two items, namely, percentage of tenant farmers in a given group, the relative importance of the beet crop compared with other farm enterprises, and the valuation of the beet land. At Los Angeles the tenure was about evenly divided between tenants and owners; at Oxnard only 20 per cent of the growers were tenants, at Salinas 64 per cent. On some farms practically all the tillable area is in beets. In such instances all the insurance and taxes are chargeable against this crop. At Los Angeles and Oxnard taxes were higher than in the Salinas area. As a result of the influence of these several factors the cost per acre for insurance and taxes in the Los Angeles and Oxnard districts averaged about $2, while at Salinas it was only about half that figure.

INTEREST AND RENT.

Interest on the land investment, where the owner is the operator, and rent where the operator is a tenant, are probably the most variable factors.

The current rate of 7 per cent on first-mortgage notes was used in computing interest. The cash paid out for rent of land or the value of the part of the crop given to the landlord as rent was used in figuring the rental charge. Some of the factors affecting these

charges are value of land, amount of cash paid as rent, proportion of the crop given as rent, the yield of beets, and the price received per ton.

In the areas studied the value of the share given for the use of the land exceeds the cash paid for this same privilege. However, the element of risk enters into the consideration. A share renter runs less risk of failing to meet his rent than the cash renter. In poor crop years the cash renter usually has to pay the same rent as in seasons of good crop yields, while the smaller the yield the less the actual number of tons of beets the tenant must give to the landlord. In sections where $6 a ton is received for beets, the value of one-fourth of the crop is greater than where $4.50 a ton is received for the crop.

At Los Angeles sugar beets brought an average of $5.79 a ton; at Oxnard, $6.88 a ton; at Salinas, $5.58.

The land values were highest at Los Angeles, where the average value of sugar-beet land was $494 per acre. At Oxnard and Salinas the values were $294 and $328 per acre, respectively. In the Los Angeles and Salinas districts about one-fourth of the land in beets was farmed by the owners; at Oxnard about 60 per cent. At Los Angeles about one-third of the beet land was cash rented, at Oxnard 22 per cent, and at Salinas 18 per cent. The highest average cash rent was paid at Los Angeles ($26.33 an acre), the lowest at Oxnard ($12). At Salinas the cash rent averaged $15.06 an acre. Of the share renters the major portion gave one-fourth of the crop to the landlord. A little over one-third of the beet land in the Los Angeles area was share rented, about one-fifth was share rented at Oxnard, while over one-half was share rented at Salinas. The highest share rent was paid in the Los Angeles district ($22.13), and the lowest in the Oxnard region ($15.82). At Salinas the share rent was $20.12 per acre.

MACHINERY.

Interest on investment, depreciation, and annual repairs, taken together, make the total annual machinery charge. This total charge was used in the case of implements used exclusively on the beet crop, and a fair proportion of this charge for implements used in common with other crops or farm enterprises.

The machinery charge was fairly uniform at Los Angeles and Oxnard, but was considerably higher at Salinas. This difference is due in a measure to the type of tillage implements used. At Salinas very deep tillage is practiced, and heavy and expensive implements are necessary to do the work. The cost per acre for machinery was $2.50 at Oxnard, $2.80 at Los Angeles, and $3.25 in the Salinas district.

MISCELLANEOUS EXPENSE.

All expenses not hitherto provided for have been grouped as "miscellaneous." It has been found that a rough approximation of this item can be reached by taking 3 per cent of the cost of labor and materials combined. The figures for miscellaneous expense are fairly uniform for the three districts.

SUMMARY AND DISTRIBUTION OF COSTS.

In making plans for greater efficiency in the production of sugar beets, it is necessary to know something of the relative importance of the different items of cost. To improve methods which reduce the cost of an item that constitutes only 1 per cent of the total cost may be merely a waste of time. However, if an item representing 50 per cent of the total cost can be reduced one-half, then something worth while has been accomplished.

Labor is the largest item of expense, constituting about 50 per cent of the total cost of production. (See Table XXVII.) The cost of materials is about 5 per cent of the total cost, while the remainder is taken up by other costs.

TABLE XXVII.—*Summary and distribution of costs.*

District.	Cost per acre.	Cost per ton.	Distribution of costs.		
			Labor.	Materials.	Other costs.
			Per cent.	*Per cent.*	*Per cent.*
Los Angeles	$67.11	$4.62	46	6	48
Oxnard	54.88	5.76	52	5	43
Salinas	66.45	4.26	54	6	40

The largest item in the labor cost is man labor, exclusive of contract labor. This constitutes about 55 per cent of the total labor cost. The cost of seed is about 65 per cent of the cost of materials, while the interest and rent make up the greater part of the other costs.

DISTRIBUTION OF RECORDS ACCORDING TO COST PER TON.

All of the records were sorted in reference to the cost per ton of producing sugar beets. The growers producing beets for $3 a ton, or under, made up one group; those producing for an average of $3.50 were put in another class and so on. A frequency curve was then constructed which shows the number of growers in each group and also the average yield per acre for each class. (See fig. 25.)

The $5 class is the largest, containing about 22 per cent of the growers. In the three larger groups 45 per cent of the farmers

are represented. The cost per ton in these groups ranges from $4 to $5.50. The growers for the three areas studied received an average of $5.88 a ton for their beets, which means a profit of 38 cents a ton for the $5.50 group and a loss of 12 cents a ton for the $6 group. At this rate, 19 per cent of the farmers, producing about 11 per cent of the total tonnage, are not making any profit growing sugar beets. They are living on the interest on their investment.

It will be noticed that, generally speaking, those producing high yields per acre had low costs per ton and those who produced low yields per acre had high costs per ton. In the case of the $6 and the $6.50 groups, an analysis shows that the farms in the former class grew an average of 146 acres of beets per farm, while those in the latter grew only 49 acres of beets per farm. It is usually found that the larger the acreage in beets the more efficiently certain opera-

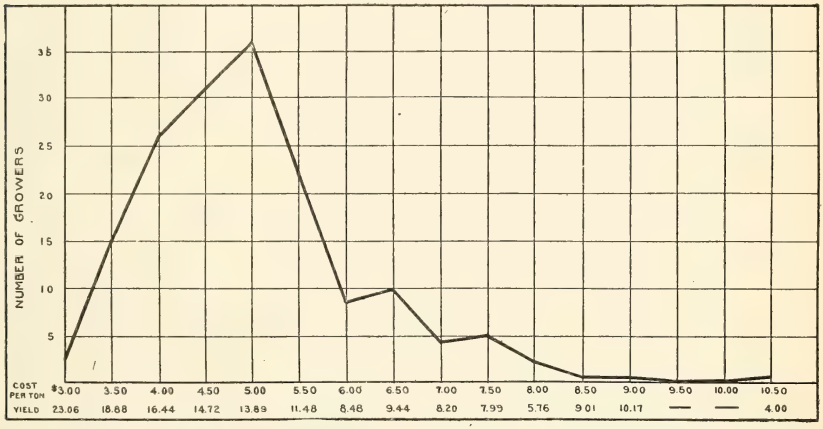

FIG. 25.—Curve showing the distribution of operators and the relationship of yield per acre to cost per ton.

tions can be performed and the lower the cost will be per ton. The yield undoubtedly is a very important factor affecting the cost per ton.

AVERAGE RETURNS AND MARGIN ABOVE COST.

In all the areas studied beets are bought on contract by the sugar factories. At Los Angeles beets were paid for on the sugar test. Beets testing 11 per cent sugar and under brought $3.50 per ton, with an increase of 25 cents per ton for each additional 1 per cent above 11 per cent until 15 per cent was reached. Above 15 per cent an increase of 30 cents a ton was paid for each additional 1 per cent. A bonus of 50 cents a ton was added to this amount for the 1916 crop. When the wholesale price of sugar was raised beyond expectation during the crop year an additional bonus of 50 cents a ton was given to the grower, making a total bonus of $1 per ton.

The same scale of prices was in force in the Oxnard area for the 1916 crop, including the bonus of 50 cents a ton for the beets.

In the Salinas area certain records were obtained from tenants who rented beet land from the sugar company. In 1916 these tenants received from $4.50 to $5 a ton for beets. The scale for the growers who did not rent sugar-company land started at $5.25 for beets testing 15 per cent sugar, with an addition of 25 cents per ton for each 1 per cent above 15 per cent.

It can be plainly seen that on account of the difference in amounts received per ton for the beets and the variation in yield that the receipts per acre would not be uniform for the three regions. The largest average price, $6.88 a ton, was received at Oxnard, the Salinas and Los Angeles growers getting a slightly lower price. By subtracting the cost of production from the receipts there is left a margin of from slightly more than $10 to almost $21 an acre. (See Table XXVIII.) Figured on the ton basis, the net returns per ton from beets alone ranged from $1.12 at Oxnard to $1.32 at Salinas. In addition to this amount there is a benefit received from the beet tops, whether sold, fed, or plowed under, which brings the average net return up to from $12.99 to $23.41 per acre.

TABLE XXVIII.—*Average returns and margin above cost.*

District.	Yield per acre.	Beet receipts per acre.	Cost per acre of beets.	Net returns per acre for beets alone.	Net returns per acre including beet tops.
	Tons.				
Los Angeles	14.52	$84.04	$67.11	$16.93	$19.68
Oxnard	9.53	65.56	54.88	10.68	12.99
Salinas	15.59	87.06	66.45	20.61	23.41

THE EFFECT OF SIZE OF BEET ACREAGE AND YIELD PER ACRE ON THE COST OF PRODUCTION.

It has already been indicated that the yield of beets is one of the most important factors affecting the unit cost of production. There is also another factor which materially affects the cost of production, namely, the size of the beet acreage.

To bring out the effect of these two factors, all the records were classified according to acreage in beets. The first group contained the farms producing 40 acres and under, the second those growing 41 to 70 acres, and the third, those producing 71 acres and over. Each group was then subdivided into three classes according to whether the yield per acre was 10 tons or less, 11 to 15 tons, or 16 tons or over. (See Table XXIX.)

TABLE XXIX.—*Relation of acreage and yield to cost of producing beets.*

Acres in beets.	10 tons or less per acre.			11 to 15 tons per acre.			16 tons or over per acre.		
	Number of farms.	Cost per acre.	Cost per ton.	Number of farms.	Cost per acre.	Cost per ton.	Number of farms.	Cost per acre.	Cost per ton.
40 and under	15	$54.04	$6.63	16	$66.93	$5.29	18	$80.77	$4.50
41 to 70	14	57.46	6.03	18	67.54	4.83	15	79.31	4.22
71 and over	16	50.84	5.97	25	62.05	4.60	28	73.85	4.05

It will be noticed that the group growing 40 acres and under had a higher acre cost than the growers producing 71 acres and over, but that the group growing 41 to 70 acres had a higher acre cost than the first group except in the case of farms with a yield of 16 tons or over per acre. An analysis of the records in this group shows that the major portion of these records was obtained in the Los Angeles and Salinas areas, where the acre costs were uniformly higher than in the Oxnard area. Generally speaking, however, the larger the acreage devoted to sugar beets, the smaller is the cost of production per acre.

The effect of both acreage and yield can be plainly seen in the cost per ton. The higher average yields in the group which produced 41 to 70 acres throw this group into its logical place in relative unit cost. As the acreage and yield increase there is a uniform decrease in the cost per ton.

VALUE OF THE SUGAR-BEET TOPS.

The sugar-beet tops are a valuable by-product of the sugar beet, and their value depends on the use made of them. The tops may be fed to stock or plowed under. They may be sold as pasture on the farm (see fig. 26) or sold and hauled away from the farm. Some growers may combine two or more of these practices, especially if the beet acreage is very large. (See Table XXX.)

TABLE XXX.—*Disposition and estimated acre value of sugar-beet tops.*

District.	Number of farm records.	Per cent feeding.	Value when fed.	Per cent selling.	Value when sold.	Per cent plowing under.	Value when plowed under.
Los Angeles	81	10	$3.04	42	$2.82	9	$2.67
Oxnard	45	11	2.82	51	2.37	29	2.08
Salinas	39	.....	.....	18	3.25	56	3.61

Among the Los Angeles and Oxnard growers the general practice was to sell the tops as pasture. Forty-two per cent of the former and 51 per cent of the latter handled the tops in this manner. About 10 per cent in each of these areas fed tops to stock kept on the farm. In the Los Angeles district 39 per cent of the growers combined two

or three methods of handling. It will be noticed that in these areas the highest valuation was placed on the tops when fed to stock on the farm, the next highest on tops sold and the lowest when the tops were turned under for manure. Where combinations of methods were employed, the results show that the acre value depends on the percentage of tops handled in a given manner, a higher valuation resulting when the greater percentage of tops was fed or sold, than when plowed under.

In Salinas it is not the common practice to pasture the tops with stock on the farm since very little stock other than work stock is kept. Then, too, the scarcity of farm manure makes it advisable to plow under the tops. Fifty-six per cent of the growers followed this practice, 18 per cent sold the tops to be pastured on the field, and

FIG. 26.—Dairy cattle feeding on beet tops. A temporary fence separates the cattle from the part of the field not yet harvested.

the remainder combined these methods of handling. A higher valuation was placed on the tops when plowed under than when sold. However, the highest acre value ($4) was reported where part of the tops were fed to stock on the farm and the remainder plowed under.

Generally speaking, beet tops are of the greatest value when fed to farm stock by the operator and of least value when plowed under, and of more value when sold as pasture on the field than when sold and hauled away from the farm. (See fig. 27.)

BEET RECEIPTS IN COMPARISON WITH OTHER FARM RECEIPTS.

Table XXXI shows how beet receipts compare with other farm receipts on these farms. It will be seen that 92 per cent to 98 per cent of the farm receipts came from the sale of crops. Considerably more than 50 per cent of the farm receipts in the Los Angeles and

Salinas areas were derived from the sale of sugar beets alone, while at Oxnard about 43 per cent came from sugar beets. In this last section the bean is a competing crop, about 46 per cent of the receipts resulting from the sale of beans. Beans and beets combined furnished 89 per cent of the total farm receipts.

TABLE XXXI.—*Beet receipts in comparison with other farm receipts.*

District.	Number of farm records.	Average total receipts per farm.	Per cent of farm receipts from—			Per cent of farm receipts from beets.	Per cent of crop receipts from beets.
			Crops.	Live stock.	Miscellaneous.		
Los Angeles	81	$8,159.60	92	7	1	84	91
Oxnard	45	4,192.16	98	1	1	43	44
Salinas	39	8,197.56	97	2	1	66	68

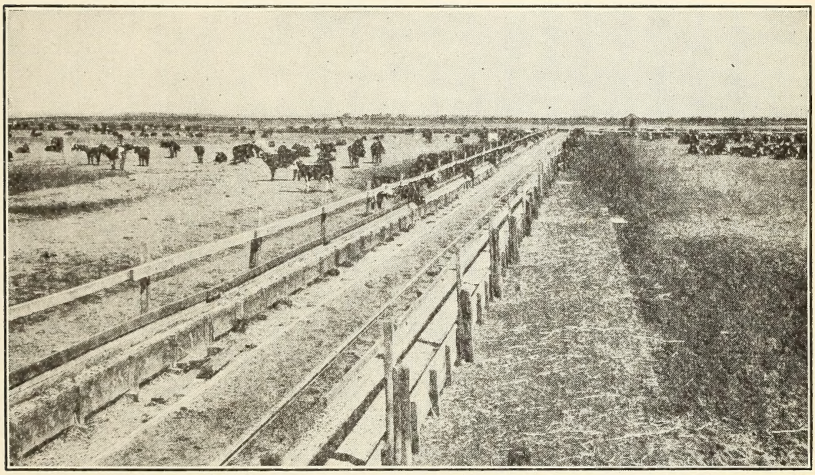

FIG. 27.—Feeding yards at Betteravia, Cal., where beet pulp constitutes an important part of the ration.

The receipts from live stock and live-stock products are second in importance, while not more than 1 per cent of the receipts in any of the three sections came from sales other than crops or live stock.

It can be stated that in Los Angeles and Salinas the farms are specialized and can be properly classed as beet farms, while at Oxnard the type can be designated as bean and beet farms.

There is certainly a field for more diversified farming in these areas. Since crops like barley, alfalfa, potatoes, and beans can be grown successfully, there is no good reason for depending on a single crop. In sugar-beet areas of Michigan, Ohio, Colorado, Utah, and Idaho, live stock fits in with the general farm scheme and utilizes to good advantage the beet tops, alfalfa, and other roughage produced on the farm. More live stock in the California beet region would mean more manure to keep up the soil fertility and a better

distribution of profitable labor throughout the year. The development of a sound cropping system at the same time would increase yields by adding humus to the soil.

LABOR REQUIREMENTS.

It has already been pointed out that the sugar beet is an intensive crop and requires a great amount of labor, some of which is hired and paid on a contract basis. In discussing labor requirement, the cash amount paid out for contract labor has been converted to man-hours, using a rate of 25 cents per hour. It is generally conceded that the expert labor that contracts this work receives a higher wage per hour than the regular farm labor. (See Table XXXII.)

TABLE XXXII.—*Labor requirements in producing an acre of sugar beets.*

District.	Acres grown.	Hours of man labor.			Total hours per acre.	
		Farmers' labor.	Contract.		Man labor.	Horse labor.
		Machine operations.	Contract price.	Equivalent hours.		
Los Angeles	7,711.5	27.7	$15.01	60.0	87.7	109.3
Oxnard	2,811.0	20.2	14.82	59.3	79.5	111.5
Salinas	3,616.0	25.7	18.87	75.5	101.2	124.3

In these three districts all of the hand labor was done on a contract basis. The machine operations are given separately so that the reader may see the relation between this part and the total man labor. The number of man hours per acre expended at Oxnard is considerably less than for the other two areas, since the yield at Oxnard is the lowest and irrigation was not practiced in this area.

The horse labor necessary to produce an acre of sugar beets was fairly uniform at Los Angeles and Oxnard, but slightly greater at Salinas, where, on account of the character of the soil, the work is heavier, and larger teams are used, than in the other areas.

The cash paid out for contract labor was almost $3 per acre more at Salinas than anywhere else. For the most part the contract labor at Salinas includes not only the cost of irrigation water but also the man labor necessary to do this work. When the cost of irrigation is deducted from the contract labor cost, there is no very wide variation in the amount paid out for contract labor in the three areas.

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